

# Modulo

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The word ***modulo*** is the Latin ablative of modulus. It was introduced into mathematics in the book *Disquisitiones Arithmeticae* by Carl Friedrich Gauss in 1801. Ever since however, "modulo" has gained many meanings, some exact and some imprecise.

- (This usage is from Gauss's book.) Given the integers  $a$ ,  $b$  and  $n$ , the expression  $a \equiv b \pmod{n}$  (pronounced " $a$  is congruent to  $b$  **modulo**  $n$ ") means that  $a$  and  $b$  have the same remainder when divided by  $n$ , or equivalently, that  $a-b$  is a multiple of  $n$ . For more details, see modular arithmetic.
- In computing, given two integers,  $a$  and  $n$ ,  $a$  **modulo**  $n$  is the remainder after numerical division of  $a$  by  $n$ , under certain constraints. See modulo operation.
- Two members of a ring or an algebra are congruent **modulo** an ideal if the difference between them is in the ideal.
- Two members  $a$  and  $b$  of a group are congruent **modulo** a normal subgroup iff  $ab^{-1}$  is a member of the normal subgroup. See quotient group and isomorphism theorem.
- Two subsets of an infinite set are **equal modulo finite sets** precisely if their symmetric difference is finite, that is, you can take a finite piece from the first infinite set, then add a finite piece to it, and get as result the second infinite set.
- The most general precise definition is simply in terms of an equivalence relation  $R$ . We say that  $a$  is *equivalent* or *congruent* to  $b$  **modulo**  $R$  if  $aRb$ .
- In the mathematical community, the word **modulo** is also used informally, in many imprecise ways. Generally, to say "A is the same as B modulo C" means, more-or-less, "A and B are the same except for differences accounted for or explained by C". See modulo (jargon).

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Categories: Mathematical terminology | Disambiguation

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